

REMARKS

The above amendments to the specification on pages 4-5, 11 and 15 serve to clarify the structure referred to therein as structure (II) such that the original structure which contained R^1 , R^2 and R^3 has been amended with R^4 being substituted for R^1 , R^5 being substituted for R^2 , and R^6 being substituted for R^3 in both the structure (II) and in the definitions for structure (II). There are no other changes to the structure aside from this.

The preceding amendment to the claims serves to cancel original Claims 1, 2, 6 and 7. The amendments to Claims 3-5 and 8-9 serve only to alter the dependency of these claims from original Claim 2 to new Claim 11 since original Claim 2 has been cancelled. New Claim 10 is supported by original Claims 1, 6 and 7; and by the specification on page 5, lines 27-29; on page 6, lines 16-18 and line 32; and on page 7, lines 14-16. Original Claim 2 also provides support for new Claim 10. Support for new Claim 11 is found in original Claims 2, 6 and 7; and in the specification on page 5, lines 27-29; on page 6, lines 16-18 and line 32 and on page 7, lines 14-16. Within Claims 10 and 11, the structure (II) has been changed in comparison to structure (II) from original Claims 1 and 2. Structure (II) in new Claims 10 and 11 does not contain R^1 , R^2 and R^3 as in original Claims 1 and 2. Rather, structure (II) has been altered such that R^1 is now represented by R^4 , R^2 is now represented by R^5 , and R^3 is now represented by R^6 in both the actual structure (II) and in the definitions for structure (II). Applicants respectfully submit that no new matter has been added by the preceding amendments.

Claims 1-9 were rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement, and for failing to comply with the enablement requirement. The Examiner indicated that the claims contained subject matter not described in the specification in a manner that reasonably conveyed to one skilled in the art that the inventor(s), at the time the application was filed, had possession of the claimed invention. It was also stated that the claims contained subject matter not described in the specification in a manner so as to enable one of ordinary skill in the art to make and/or use the invention.

Applicants respectfully submit that these rejections are moot in view of the preceding amendments.

Claim 1 was rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which Applicants regard as the invention. Claim 1 was described as confusing by the Examiner.

Applicants respectfully submit that this rejection is moot in view of the preceding amendments.

Claims 1-9 were rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which Applicants regard as the invention. With regard to Claim 1, components C) and D) were described as not being mutually exclusive. Also, component D) is described as having a functionality of 1.5 to 3 but it appears to always be difunctional from the structures. Claims 1 and 2 were "confusing" as it was unclear whether formula (II) corresponded to the "phosphine oxides" language within the 3rd line of component (D). Also the use of the term "may" with respect to R1 and R2 rendered the claims indefinite. The Examiner also stated that it was confusing to have the same R variables defined differently in the same claim in Claims 1 and 2.

Applicants respectfully submit that these rejections are moot in view of the preceding amendments.

Claims 2 and 5-9 were provisionally rejected under the judicially created doctrine of obviousness-type double patenting over U.S. Application Serial No. 10/643,856.

Applicants will file a terminal disclaimer in due course. This will be either at the point that this rejection is no longer provisional or once all remaining rejections are resolved.

Claims 1-9 were rejected under 35 U.S.C. 103(a) as being unpatentable over the Quiring et al reference (U.S. Patent 4,371,684) in view of the Pelletier et al reference (U.S. Patent 3,474,047), the Lee reference (U.S. Patent 4,343,914) or the Lee et al reference (U.S. Patent 4,555,562).

Thermoplastic polyurethanes which are suitable for processing in extruders and/or on melt roll calendars are described in the Quiring et al reference. These thermoplastic polyurethanes are prepared from (A) one or more relatively high molecular weight, substantially linear polyols having a molecular weight in the range of from 400 to 10,000, (B) diphenylmethane diisocyanate and/or hexamethylene diisocyanate, and (C) a mixture of 85 to 99% by weight of 1,4-butanediol and 1 to 15% by weight of at least one co-chain extender which is selected from the group consisting of 1,6-hexanediol, ethylene glycol, diethylene glycol, triethylene glycol, neopentyl glycol, 2-ethyl-1,3-hexanediol, 1,3-butanediol, 1,2-propanediol, 1,4-bis-hydroxymethyl cyclohexane, hydroquinone bis-hydroxyethyl ether and mixtures thereof. Components (A), (B) and (C) are present in amount such that the equivalent ratio of NCO-groups in (B) to Zerewitinoff-active hydrogen atoms in (A) and (C) is from 0.9:1 to 1.2:1, and the molar ratio of components (A) to (C) being from 1:20 to 5:1.

The Pelletier et al reference discloses polyurethane compositions comprising the reaction product of polyisocyanates with hydroxyl compounds produced by the reaction of alkylene oxides with phosphonic acid. Suitable phosphonic acids are monophosphonic acids and diphosphonic acids which correspond to one of the two structures as set forth at column 1, lines 33-44 of the '047 patent. . These polyurethanes are described as having improved resistance to burning and flame propagation.

Flame retardant polyurethanes containing alkyl bis(3-hydroxypropyl)-phosphine oxide are disclosed by the Lee reference (U.S. Patent 4,343,914). These polyurethanes comprise an effective amount of an alkyl bis (3-hydroxypropyl) phosphine oxide which corresponds to the formula set forth at column 1, lines 43-47, conventional polyols, and one or more polyisocyanates. A one-shot process is typically used.

The Lee et al reference discloses polyurethane elastomer compositions. These elastomer compositions are prepared by curing a NCO terminated prepolymer derived from a polyhydroxy polyether or polyester, with a curative which contains a polyhydroxyalkylphosphine oxide which corresponds to the formula as set forth at column 2, lines 38-43.

Applicants respectfully submit that the presently claimed invention is not rendered obvious to one of ordinary skill in the art by this combination of references.

The Quiring et al reference does not disclose or suggest to the skilled artisan that TPUs prepared from MDI prepolymers may have tensile strengths above 35 MPa. Examples 5 and 6 of this reference both use MDI (diphenylmethane diisocyanate) as the isocyanate component, but neither example makes a prepolymer of the MDI. Rather, these two examples use a one-shot process to react MDI with a substantially linear bifunctional polypropylene glycol having a MW of about 2000, a hexanediol polycarbonate containing terminal hydroxyl groups and having a MW of about 2000, and different chain extenders to form the TPU. Example 5 (a comparison example) uses 1,4-butanediol at NCO/OH of 0.99, 1.00, 1.01, 1.02 and 1.03. Example 6 uses a mixture of 1,4-butanediol and 1,6-hexanediol over the same NCO/OH range. In this regard, it should be noted that the tensile strength of the TPUs from Example 5 are all above 35 MPa except Example 5c. The samples of Example 6, however, do not have a tensile strength above 35 MPa except Example 6d which was 35.1. Applicants respectfully submit that from this information, it is questionable whether the skilled artisan could reasonably expect to make TPUs with a tensile strength > 35 MPa from MDI.

By combining the Quiring et al reference with the Pelletier et al reference also does not suggest the presently claimed invention to one of ordinary skill in the art. Including a compound corresponding to the first of the two structures at column 1, lines 31-44 of Pelletier et al reference with the process of the Quiring et al reference does not clearly result in the present claimed invention. Since the second structure of the Pelletier et al reference is clearly outside the scope of Applicants' component D), this will not be discussed.

As set forth above, the Quiring et al reference does not disclose or suggest anything with regard to TPUs prepared from MDI prepolymers. The only examples in the Quiring et al reference which used MDI are one-shot systems, not prepolymers. Applicants' claims clearly require prepolymers of MDI or PMDI. Furthermore, even if one skilled in the art was motivated to make a prepolymer of MDI or PMDI and react this with a suitable chain extender and a phosphonate, sufficient information is not provided that would lead the skilled artisan to expect or believe that the resultant TPU would exhibit both (1) a high tensile strength, i.e. > 35 MPa, and (2) a low level of shrinkage, i.e. < 3%. This is simply not suggested to one skilled in the art from this combination of references.

Applicants position is supported by Comparison Example 3 of the present application. See page 18, lines 23-32 and the Table on page 23. The TPU of this system (MDI with a polyol and a phosphorus compound which contains Zerewitinoff-active hydrogen atoms) exhibited a good tensile strength but a high level of shrinkage (i.e. about 7%). This is clearly unacceptable and outside the scope of the present invention. Accordingly, the skilled artisan has no insight into the invention from the combination of the Quiring et al reference with the Pelletier et al reference.

The combination of the Quiring et al and the Lee reference also does not suggest the presently claimed invention to the skilled artisan. The Lee reference requires a specific amount of the phosphine oxide compound (i.e. an alkyl bis(3-hydroxypropyl)phosphine oxide). This reference also only discloses that these phosphine oxides improve flame retardance. No mention of high tensile strengths and/or low shrinkage is made. In addition, the Lee reference does not disclose or suggest using a prepolymer of MDI or PMDI. In fact, no mention of prepolymers is made by the Lee reference. Therefore, one of ordinary skill in the art would not or could not reasonably expect that TPUs made from the presently required components would exhibit high tensile strengths (i.e. > 35 MPA) and low shrinkage (< 3%) when containing a phosphorus containing compound to improve the flame retardancy.

The skilled artisan has no more insight into the presently claimed invention from this combination from reading this combination of references than from the Quiring et al reference combined with the Pelletier et al reference.

Finally, combining the Lee et al reference with the Quiring et al reference also does not fairly suggest the presently claimed invention to one skilled in the art. The Lee et al reference discloses elastomers comprising an NCO terminated prepolymer with curing agent comprising a polyhydroxyalkylphosphine oxide which corresponds to the formula as set forth at column 2, lines 38-43. All of the working examples of the Lee et al reference are based on 3 different TDI prepolymers. Two of these TDI prepolymers prepared from TDI and a polyester polyol, and the last was prepared from TDI and a polyether polyol. See column 4, lines 15-22. Obviously, the prepolymer prepared from TDI and a polyether polyol is most pertinent to the presently claimed invention.

This prepolymer (Vibrathane ® 602) was used in Example 9. See Table III at column 7, lines 4-60. The tensile strength reported for Example 9 was 3240 psi, which is about 22 MPa. Obviously, this is only about 63% of the tensile strength of the presently claimed TPUs. Applicants respectfully submit that one of ordinary skill in the art could not possibly expect upon reading the Lee et al reference, that substituting MDI for TDI in the prepolymer, and including a low molecular weight chain extender in the curing agent would provide a significant increase in the tensile strength and keep the shrinkage of the TPU below 3%. This is simply not suggested by the Lee et al reference, either alone or in combination with the Quiring et al reference.

It is therefore respectfully submitted by Applicants that one of ordinary skill in the art has no insight into the presently claimed invention upon reading the Quiring et al reference with the Pelletier et al reference, the Lee reference and/or the Lee et al reference. Accordingly, this rejection is improper and Applicants request that it be withdrawn.

Claims 1-6, 8 and 9 were rejected under 35 U.S.C. 103(a) as being unpatentable over the Batt et al reference (U.S. Patent 6,534,617) in view of the

Pelletier et al reference (U.S. Patent 3,474,047), the Lee reference (U.S. Patent 4,343,914) or the Lee et al reference (U.S. Patent 4,555,562).

The Batt et al reference discloses a method of preparing a thermoplastic polyurethane from (i) a hydrogenated polydiene diol having 1.6 to 2 terminal hydroxyl groups per molecule and a MW of at least about 500 to less than 20,000, (ii) an isocyanate having two NCO groups per molecule, and (iii) one or more chain extenders, and (iv) optionally, a catalyst. These TPUs may have tensile strengths of > 20 MPa.

Applicants respectfully submit that the presently claimed invention is not rendered obvious by this combination of references.

The Batt et al reference prepared TPUs from MDI prepolymers, with chain extenders such as 1,4-butanediol, 2-ethyl-2-butyl-1,3-propanediol, 2,2,4-trimethyl-1,3-pentanediol, etc. The MDI prepolymers are prepared by reacting an excess of MDI with a polydiene diol. By comparison, the TPUs of the present invention require a MDI prepolymer that is the reaction product of MDI with a polyether polyol, and a curing agent comprising a low molecular weight chain extender and a phosphonate or a phosphine oxide. Phosphine oxides are not disclosed or suggested by the Batt et al reference. Also, only one example (of 19 that represent the invention of this reference) appears to have a tensile strength > 35 MPa. See Example 16 in Table 8 at column 16, lines 28-38.

Combining this reference with the Pelletier et al reference does not fairly suggest the presently claimed invention to the skilled artisan. As discussed above, the Pelletier et al reference is directed to preparing polyurethane foams. Also, the working examples of this reference suggest that the phosphorus containing compound be reacted with the isocyanate (specifically TDI) to form a quasi-prepolymer, and this prepolymer is then foamed with a blowing agent and a polyester polyol. Comparison Example 4 of the present invention illustrates that forming a prepolymer from MDI and a phosphorus containing compound, which is then cured with butanediol does not result in a TPU exhibiting the presently desired properties. Rather, this TPU has an unsatisfactory tensile strength. The

combining the Pelletier et al reference with the Batt et al reference does not fairly suggest the present invention to one of ordinary skill in the art.

It is also disclosed by this reference (Pelletier et al) that a one-shot process can be used. However, one-shot processes are obviously not suitable for preparing the presently claimed TPUs. See Comparison Examples 2, 3 and 8 of the present application; on page 18, lines 12-32 and on page 20, lines 22-31.

Combining the Batt et al reference with the Lee reference also does suggest the presently claimed invention to one of ordinary skill in the art. As previously discussed, the Lee reference requires a specific amount of the phosphine oxide compound (i.e. an alkyl bis(3-hydroxypropyl)phosphine oxide). It also discloses that these phosphine oxides improve flame retardancy. No mention of high tensile strengths and/or low shrinkage of the resultant materials is made. Finally, the Lee reference does not disclose or suggest using a prepolymer of MDI or PMDI. In fact, no mention of prepolymers is made by the Lee reference. Therefore, one of ordinary skill in the art would not or could not reasonably expect that TPUs made from the presently required components would exhibit high tensile strengths (i.e. > 35 MPa) and low shrinkage (< 3%) when adding a phosphorus containing compound which is known to improve the flame retardancy.

Rather, the skilled artisan would believe that flame retardancy can be improved by a one-shot process with a phosphorus compound such as is disclosed by the Lee reference, or that the tensile strength can be improved by using a prepolymer prepared from MDI with a polydiene diol. However, sufficient information is not disclosed by the Batt et al reference and the Lee reference that leads one of ordinary skill in the art to reasonably expect that tensile strengths can be improved to > 35 MPa and shrinkage decreased to < 3% while maintaining the flame retardancy.


Finally, the combination of the Batt et al reference with the Lee et al reference does not suggest the present invention to one skilled in the art. As discussed above, the only example of the Lee et al reference which uses a polyether polyol to prepare the prepolymer is Example 9. Also, this is a TDI prepolymer, not a MDI prepolymer. This prepolymer (Vibrathane ® 602) in Example 9, see Table III at column 7, lines 4-

60, is the most relevant from the Lee et al reference to the present invention. The tensile strength reported for Example 9 was 3240 psi, which is about 22 MPa. This is, however, only about 63% of the tensile strength of the presently claimed TPUs. Applicants respectfully submit that one of ordinary skill in the art could not possibly expect upon reading the Lee et al reference, that substituting MDI for TDI in the prepolymer, and including a low molecular weight chain extender in the curing agent would provide a significant increase in the tensile strength and keep the shrinkage of the TPU below 3%. This is simply not suggested by the Lee et al reference, either alone or in combination with the Batt et al reference.

Accordingly, Applicants respectfully submit that the presently claimed invention is not fairly suggested to one of ordinary skill in the art from this combination of references. It is therefore submitted that these references do not render the presently claimed invention obvious under 35 U.S.C. 103(a).

In view of the preceding amendments and remarks, Applicants respectfully submit that each of the present rejections is moot. It is respectfully requested that Claims 2-5 and 8-11 be allowed.

Respectfully submitted,

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